REMARKS

Claims 1-32 were pending and presented for examination in this application.

In an Office Action dated May 17, 2007, claims 10-12 were objected to, and claims 1-9 and 13-32 were rejected.

Claims 1, 24, 27and 30 have been amended.

Claims 1-32 are pending.

Response to Rejection Under 35 USC §102(e)

The Examiner rejected claims 1-3, 13-14 and 18-32 under 35 USC §102(e) as allegedly being anticipated by Lu *et al* (US 2005/0058200). This rejection is respectfully traversed.

As amended, claim 1 recites:

A method for robust multi-pass variable bit rate video encoding, the method comprising:
an encoding manager performing a first-pass encoding of a video sequence;
the encoding manager collecting data concerning the video sequence during the first-pass encoding;
the encoding manager utilizing collected data to construct a data analysis model concerning the video sequence, the data analysis model comprising at least a frame model concerning each frame of the video sequence, and a sequence model concerning the video sequence as a whole;
the encoding manager utilizing the data analysis model to distinguish between easy and hard segments of the video sequence to determine segment complexity of each segment and to generate a variable bit rate profile for the video sequence, the variable bit rate profile complying with a bit budget for the video sequence, avoiding buffer underflow for each frame of the video sequence, and variably allocating bits to segments as a function of segment complexity; and
the encoding manager utilizing the rate profile to perform a second-pass encoding of the video sequence.

Claims 24, 27 and 30 recite similar language. The claimed invention relates to multi-pass variable bit rate (VBR) encoding. The claimed invention allows a video encoding system to vary the bit rate per frame such that individual frames are encoded at optimal bit rates and roughly constant quality throughout the video sequence is maintained. More specifically, an encoding manager performs a first-pass encoding of a video sequence, collecting modeling data concerning the sequence in the process. The encoding manager utilizes collected data to construct a data analysis model concerning the sequence, the model including bit overhead for each frame and data concerning transitions that occur during the sequence. The encoding manager uses the data analysis model to distinguish between easy and hard segments of the video sequence to determine segment complexity of each segment and to generate a variable bit rate profile for the video sequence. The encoding manager utilizes the variable bit rate profile to perform a second-pass encoding of the video sequence, variably allocating bits to segments as a function of segment complexity, and adjusting quantization and bit rate for frames as necessary to avoid underflow and conform to the bit budget for the video sequence.

Lu does not disclose the invention of claim 1. First, it is important to appreciate that Lu describes a multi-pass constant bit rate (CBR) video coding system, not a variable bit rate coding method as claim. See Lu, Abstract, which states "A real-time MPEG video coding system with information look-ahead for constant bit rate (CBR) applications…" and Lu [0006] which states "It would thus be highly desirable to provide a real-time MPEG CBR video coding method and associated system…." The differences between CBR and VBR coding systems are apparent to one of ordinary skill in the art. In general, CBR is useful for streaming multimedia content on limited capacity channels since it is the maximum bit rate that matters, not the average. In

contrast, VBR varies the amount of output data per time segment. VBR allows a higher bitrate to be allocated to the more complex segments of video frames while less bitrate is allocated to the less complex segments. The average of these varying bitrates represents the uniform overall good quality of the whole video sequence. Consequently, the bit rate control goals are different for VBR and CBR coding systems, and consequently how these approaches are different as well.

Indeed, the difference between CBR and VBR is expressly described by Blawat *et al* (US 6,198,878), the reference cited by the Examiner for the §103(a) rejection. Blawat states that the bit rate control goals for applications using storage devices with the capability to process a VBR data stream differ from the CBR case. See Blawat, Abstract. The bit rate control goal for VBR data stream encoding is to maintain uniform quality over time. See Blawat, Column 2, lines 1-6. The case for CBR data stream encoding is to maintain constant number of bits output to transport channel in each field (i.e. frame) period. See Blawat, Column 1, lines 45-64. Thus, the references cited by the Examiner clearly admit that CBR is different both in its goals and implementation from VBR.

Second, it follows Lu does not disclose or teach distinguishing "utilizing the data analysis model to *distinguish between easy and hard segments of the video sequence to determine segment complexity of each segment and to* generate *a variable bit rate* profile for the video sequence…" and "and *variably* allocating bits to segments as a function of segment complexity" as claimed. In Lu, as the Examiner admitted, only single frame complexity is considered in the bit allocation calculation. Thus, Lu does not disclose a determination of segment complexity. It further follows that Lu does not disclose *variably* allocating bits to segments as a function of

segment complexity. As claimed, each frame is encoded with different bit rate based on its content complexity and other factors. Lu simply does not disclose these features.

Finally, Lu's target bit allocation plan for the video frames does not disclose or teach the variable bit rate profile for the video sequence as claimed. Lu's target bit allocation plan is designed for CBR applications where roughly constant bits are allocated to each video frame. Such design logic is clearly demonstrated in Lu's target bit allocation plan algorithm steps. In Lu's step 2, the target number of bits for all frames is calculated using the bit rate R and frame rate F. See Lu, [0024]. The bit rate R in Lu is a constant bit rate for each frame of the video sequence. This is because Lu's bit rate control is designed for CBR applications, and if R is not the constant bit rate for each frame of the video sequence, it would have been indexed as P_i, C_i, M_i, Q_i and T_i in the calculation for each individual frame. Furthermore, in Lu's step 3, the target bit allocation is adjusted to prevent buffer overflow and underflow. However, how large is such adjustment is controlled by a guard band G, and G is 3% ~ 5% of the total decoder buffer size V. See Lu, [0025] and [0026]. As such, a constant bit rate, not a variable bit rate, for each frame is maintained in Lu's bit rate control, in contrast to the claimed "variable bit rate profile."

Based on the above remarks, Applicants respectfully submit that for at least these reasons claims 1, 24, 27 and 30 are patentably distinguishable over the cited reference. Therefore, Applicants respectfully request that Examiner reconsider the rejection, and withdraw it.

The dependent claims are also patentable over Lu, both because each depends from patentable independent claims, respectively, and because each also recites its own patentable features. Therefore, Applicants respectfully submit that claims 1-3, 13-14 and 18-32 are not anticipated by Lu.

Response to Rejection Under 35 USC §103(a)

In the 4th paragraph of the Office Action, Examiner rejects claims 4-9 and 15-17 under 35 USC §103(a) as allegedly being unpatentable over Lu *et al* (US 2005/0058200) in view of Blawat *et al* (US 6,198,878). This rejection is respectfully traversed.

In the rejection of claims 4-9 and 15-17, the Examiner acknowledges that Lu is silent in regards to explicit of overhead bit, and asserts that this feature is disclosed in Blawat. However, Blawat does not teach or suggest overhead bit in the VBR rate profile generation as claimed. Moreover, Blawat does not disclose or suggest multi-pass VBR encoding as claimed.

Blawat disclose a single-pass encoder control strategy adapted for processing VBR data stream. See Abstract. The portions of Blawat relied upon by the Examiner in the rejections of claims 4-9 and 15-17 further highlight the distinctions between CBR rate control strategies disclosed by Lu described above and the claimed invention. For example, Column 3, lines 35-41 is simply a summary of CBR bit allocation (global control) in regards to explicit of overhead bit. As such, Blawat does not disclose the claimed invention, singly or in combination with Lu.

Conclusion

For the above reasons, Applicants respectfully submit that the pending claims are allowable over the cited references. The dependent claims incorporate the limitations of their base claims and are allowable for at least the same reasons. Accordingly, Applicants respectfully request the allowance of the application. The Examiner is invited to contact the undersigned by telephone in order to advance the prosecution of this case.

Respectfully submitted,
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